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Kozaki et al.

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(54) **SHEET CONVEYING DEVICE**

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(51) **Int. Cl.**
B65H 5/02 (2006.01)

(52) **U.S. Cl.**
USPC **271/274**; 271/314

(58) **Field of Classification Search**
USPC 271/264, 274, 314
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2007/0210512	A1	9/2007	Sakakibara et al.	
2010/0244360	A1 *	9/2010	Yamamoto	271/10.01

FOREIGN PATENT DOCUMENTS

JP	H02-144363	A		6/1990
JP	H07-330187	A		12/1995
JP	2002-274689	A		9/2002
JP	2007-238252	A		9/2007
JP	2008156108	A	*	7/2008
JP	4497751	B2		7/2010

OTHER PUBLICATIONS

Translation of JP 2008-156108 A.*
Japan Patent Office, Notice of Reasons for Rejection for Japanese Patent Application No. 2011-079515 (counterpart Japanese patent application), mailed Jan. 22, 2013.
* cited by examiner

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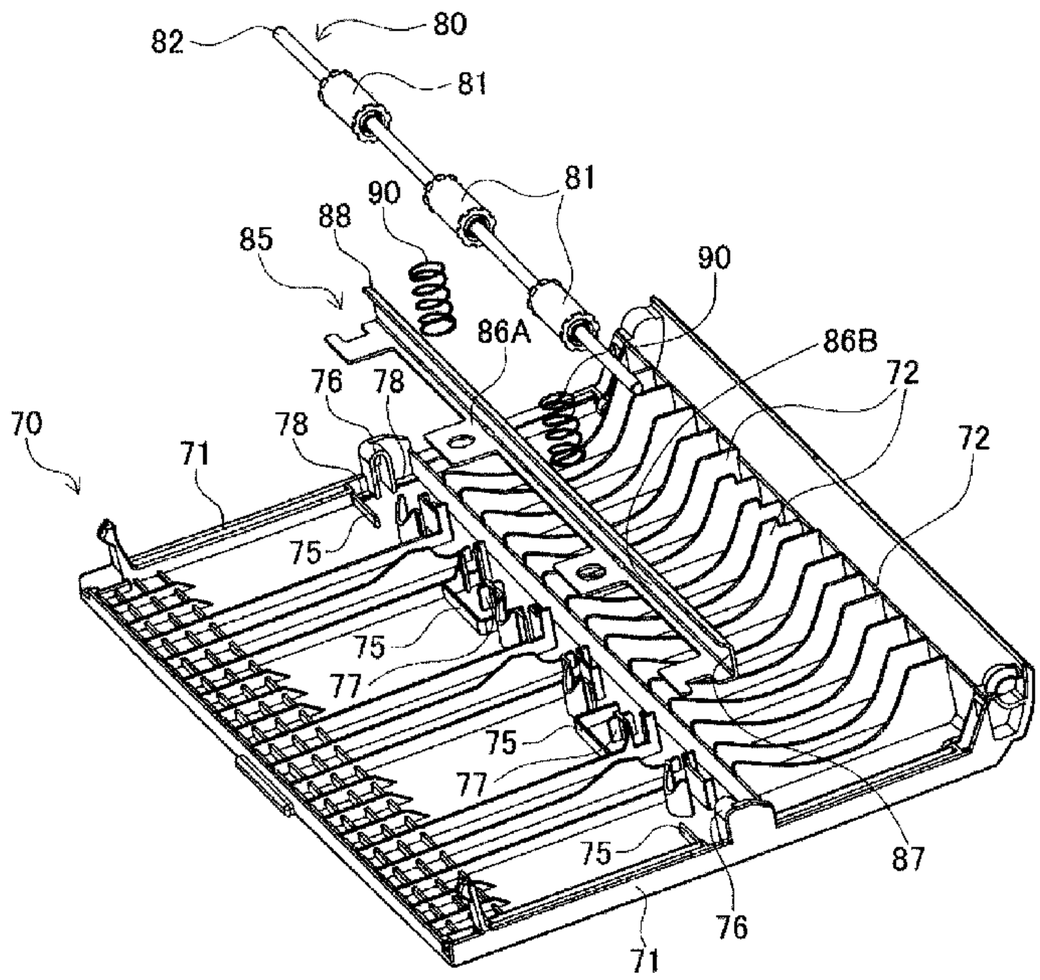
(57) **ABSTRACT**

A sheet conveying device includes a cover member made of resin and partially defining a conveying path, a roller member rotatably disposed on the cover member and configured to convey a sheet along the conveying path, an urging member disposed between the cover member and a rotary shaft of the roller member and urging the roller member toward the conveying path while one end of the urging member contacts the rotary shaft, and a plate member made of metal and disposed between the cover member and the urging member. The plate member includes a first segment extending along the cover member and contacting the other end of the urging member, a second segment extending from an edge of the first segment in a direction toward the conveying path, and a third segment extending from an edge of the second segment in a direction different from the second segment extending direction.

13 Claims, 9 Drawing Sheets



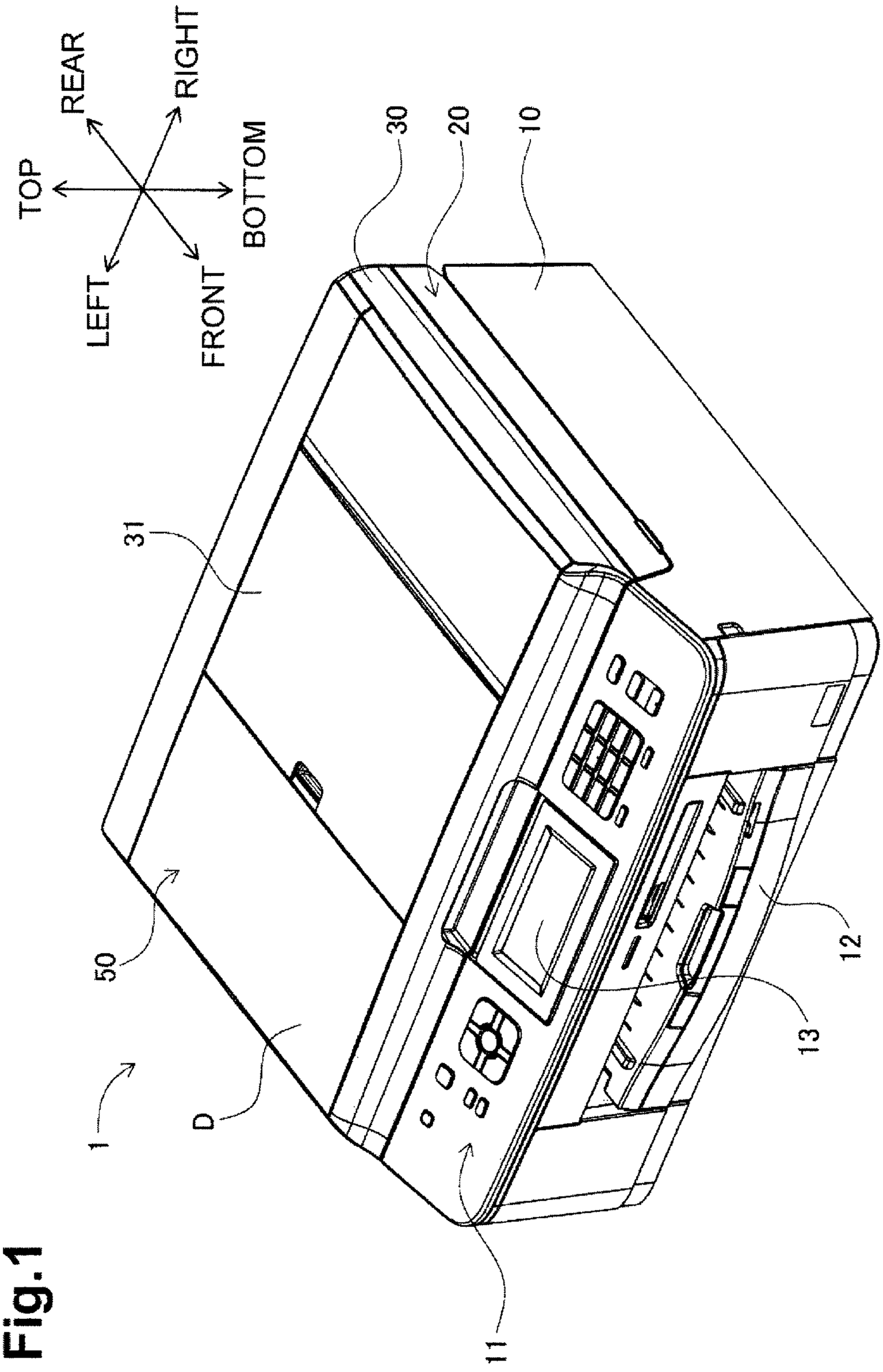


Fig.1

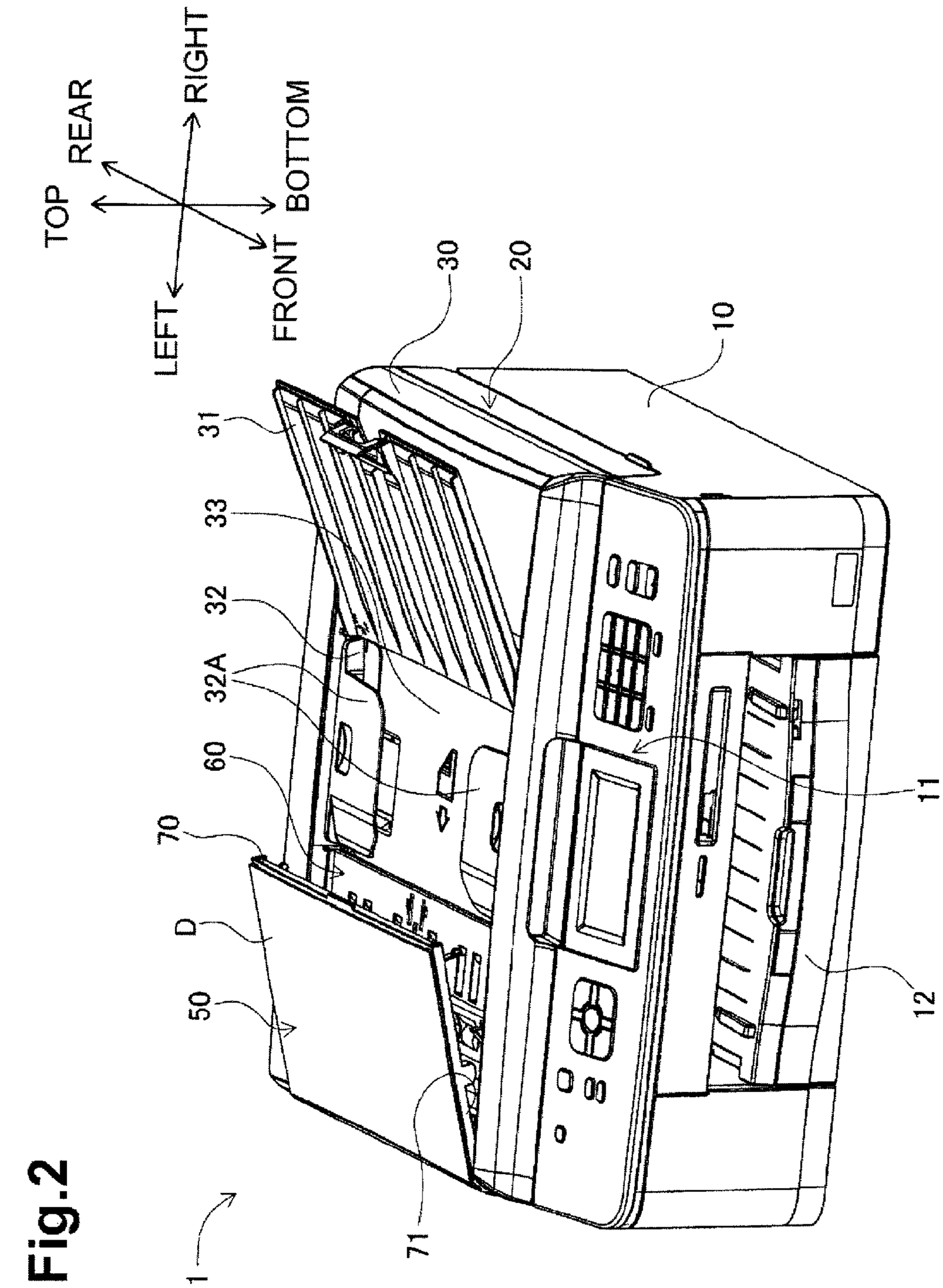

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Fig.2

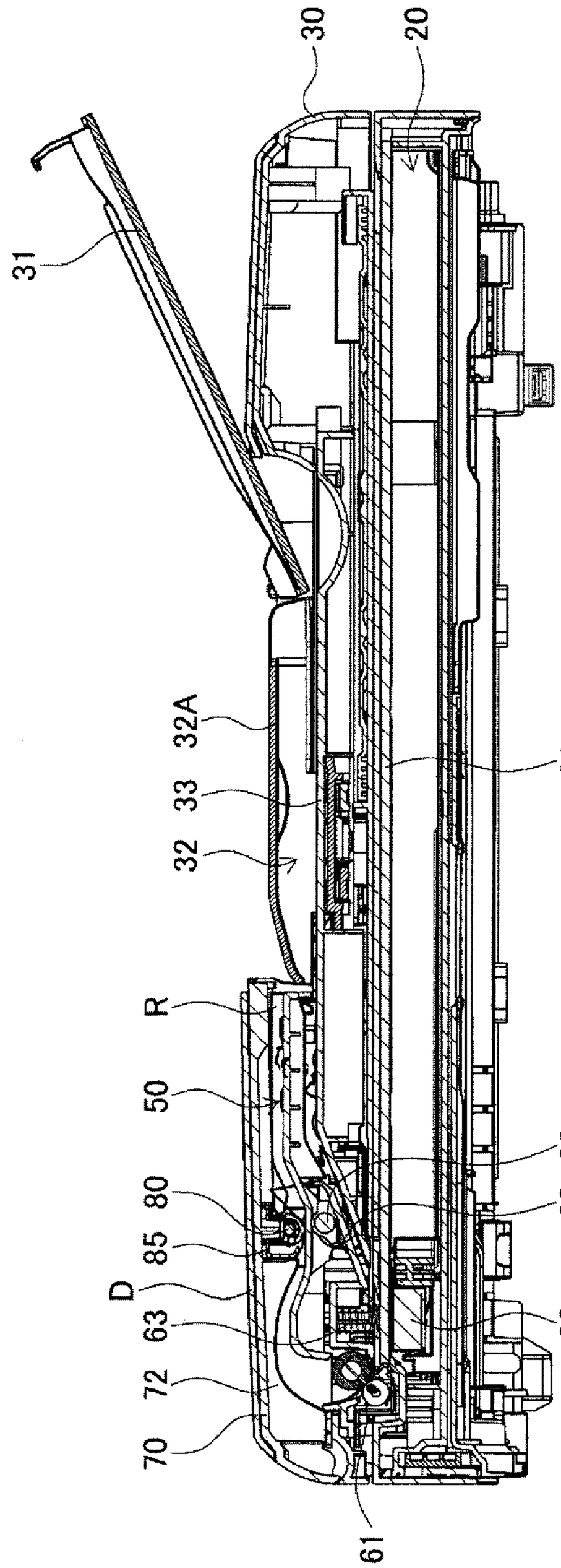

Fig.3

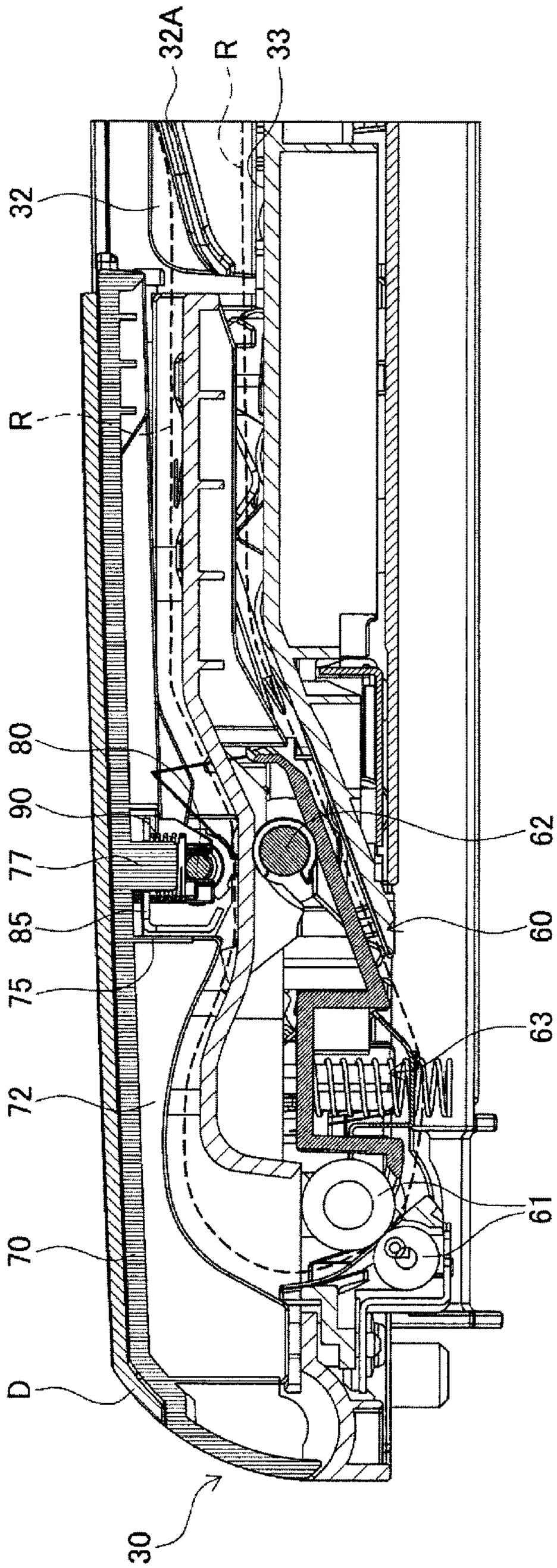

Fig.4

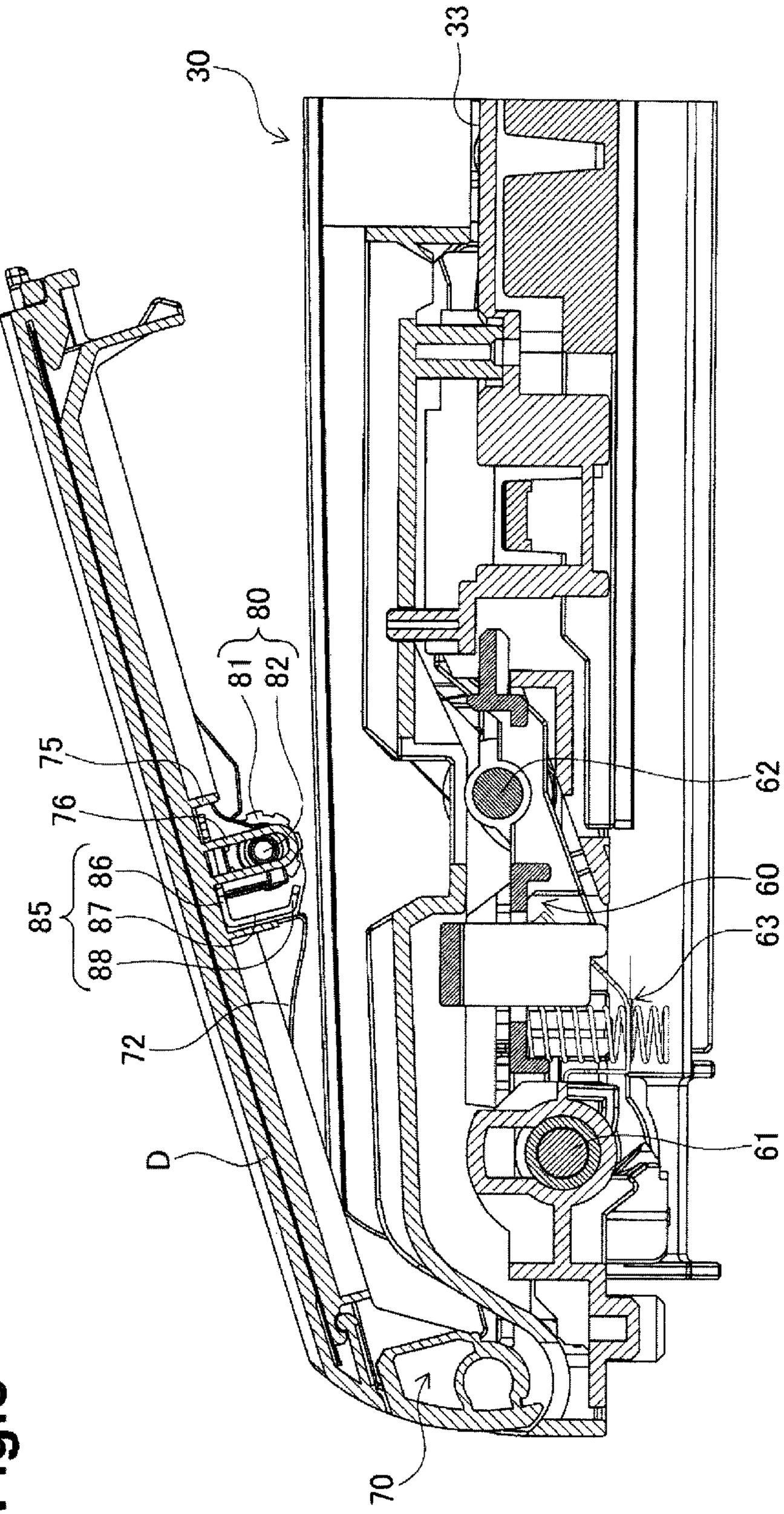

Fig.5

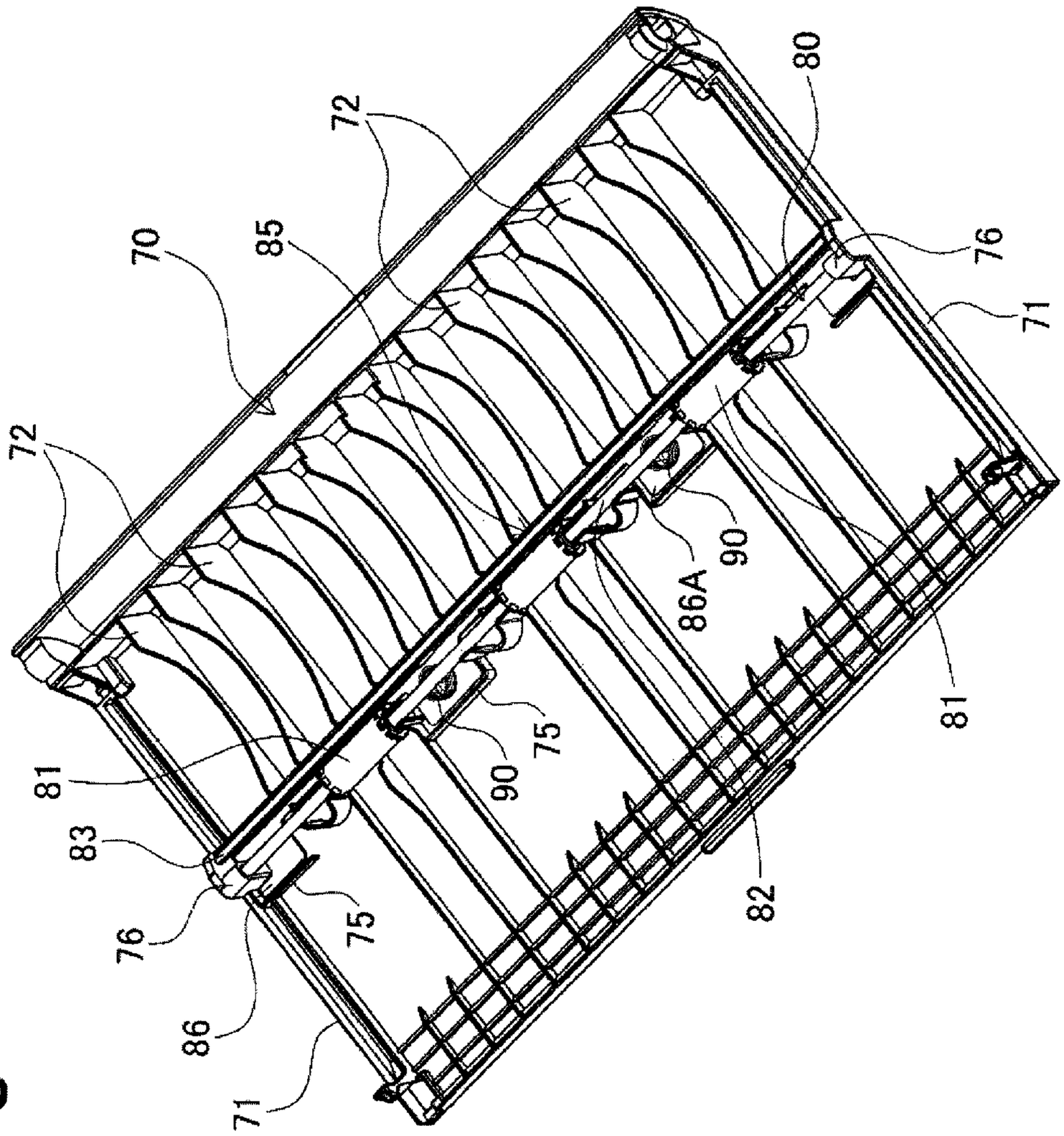

Fig.6

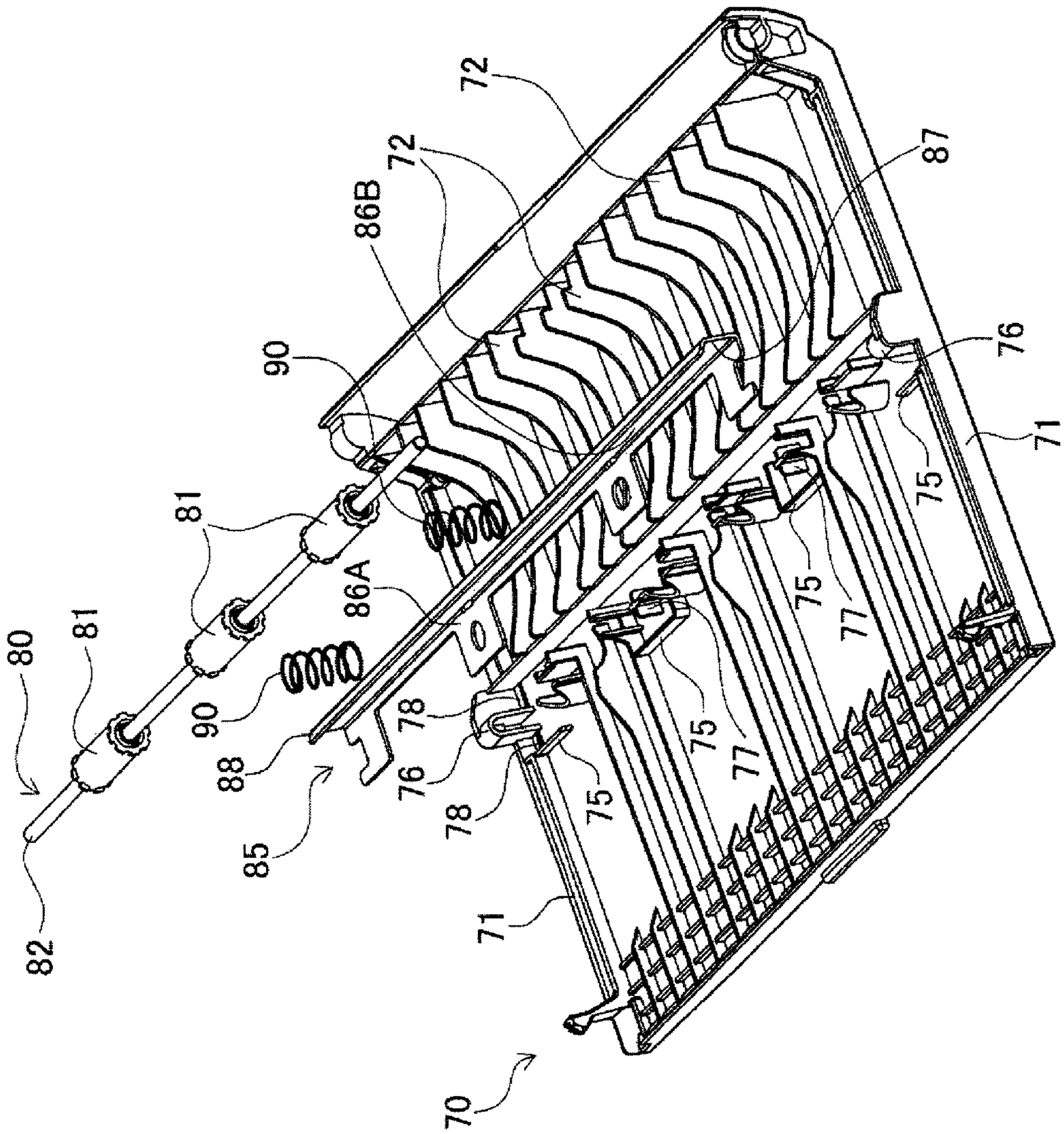
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Fig.7

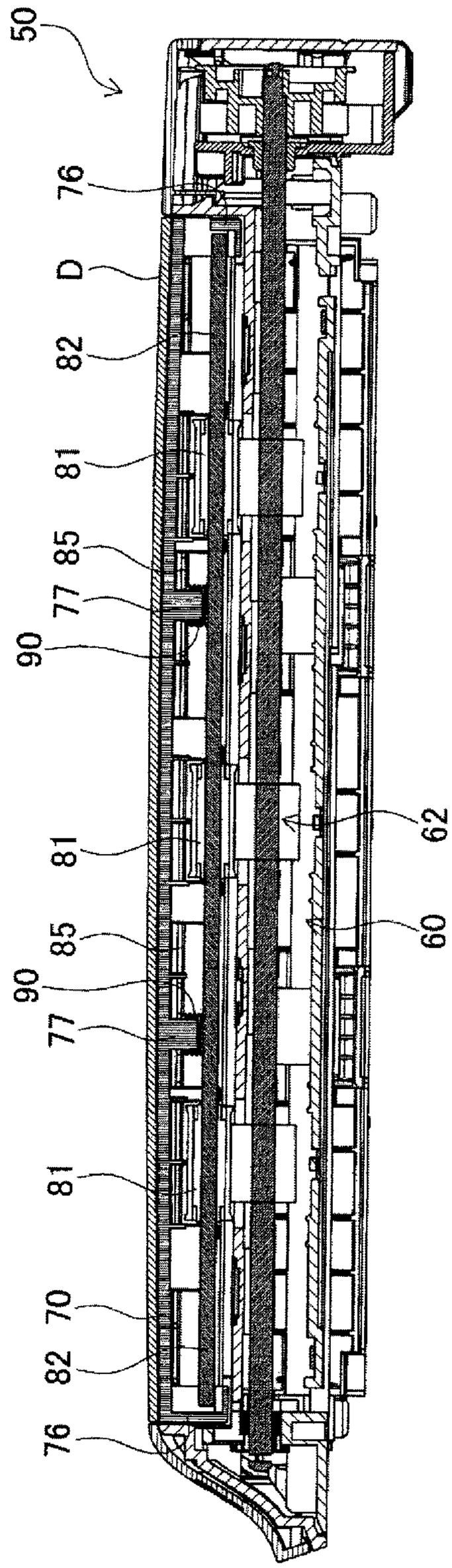
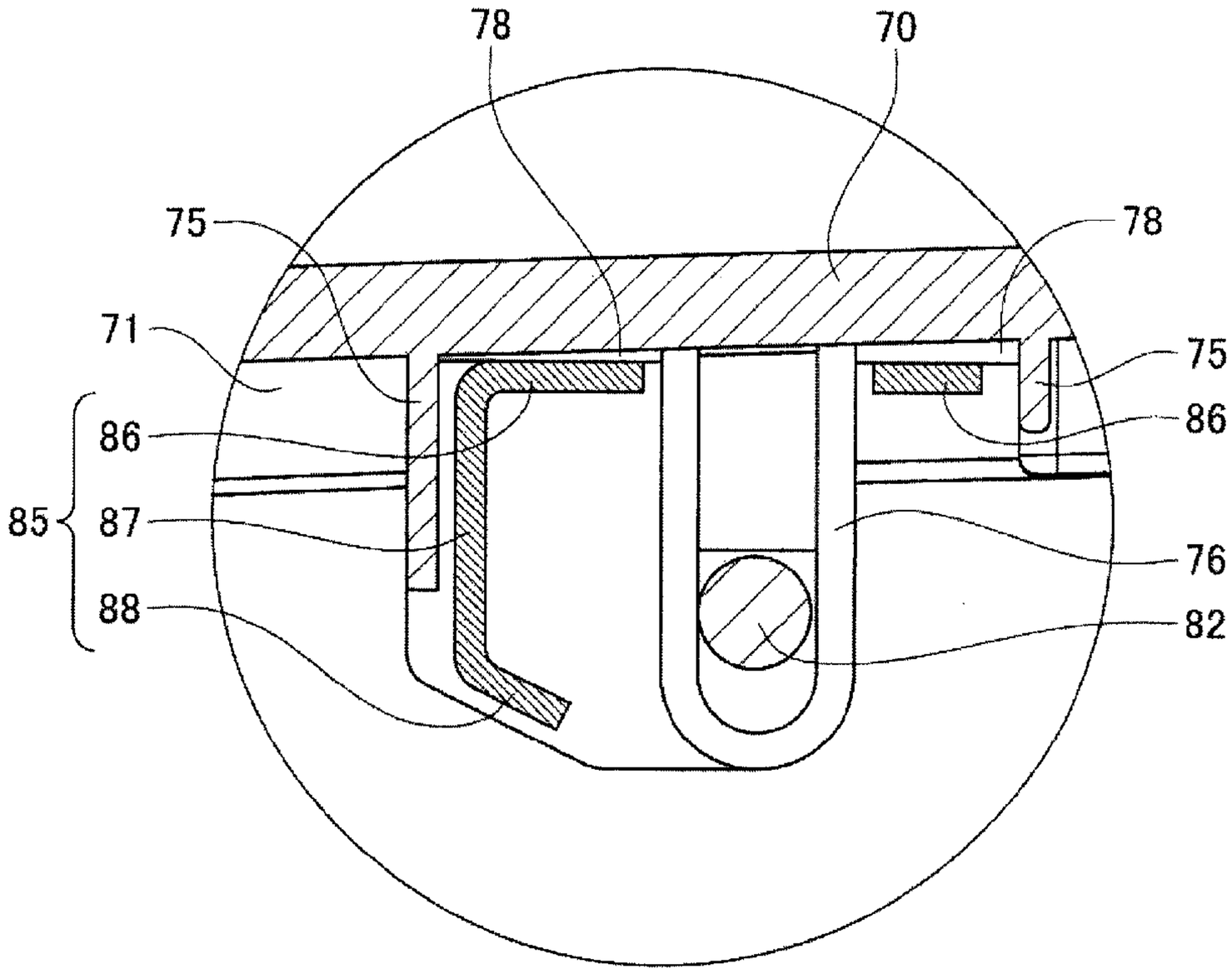


Fig.8

Fig.9



SHEET CONVEYING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2011-079515, filed on Mar. 31, 2011, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a sheet conveying device configured to convey a sheet along a conveying path.

2. Description of Related Art

A known multi-function device and a known scanning device each comprise a sheet conveying device. The sheet conveying device is configured to convey sheets from a sheet stacking location along a conveying path such that images on the sheets are sequentially scanned.

A known sheet conveying device comprises a cover member made of resin and defining a part of a sheet conveying path, and a roller member disposed on the cover member and configured to rotate and convey a sheet along the sheet conveying path. The sheet conveying device further comprises an urging member disposed between the cover member and a shaft of the roller member. The urging member urges the roller member by contacting, at its one end, the roller member and, at its other end, the cover member, such that the roller member reliably contacts the sheet. Thus, when the roller member rotates, the roller member reliably conveys the sheet.

There has recently been a demand for compact and slim sheet conveying devices. In order to meet such a demand, it is conceivable to reduce the thickness of the cover member of the above-described sheet conveying device. In this case, however, the cover member may deform due to urging force of the urging member because one end of the urging member contacts the cover member. Because the cover member of the above-described sheet conveying device defines an outer surface of the sheet conveying device, such deformation may deteriorate the appearance of the device.

SUMMARY OF THE INVENTION

Therefore, a need has arisen for a sheet conveying device that overcomes these and other shortcomings of the related art and is configured to be slim while a cover member made of resin is prevented from deforming due to urging force of an urging member.

According to an embodiment of the invention, a sheet conveying device comprises a cover member made of resin and defining a part of a conveying path along which a sheet is conveyed, a roller member rotatably disposed on a conveying path facing side of the cover member and configured to convey the sheet along the conveying path, an urging member disposed between the cover member and a rotary shaft of the roller member and urging the roller member toward the conveying path in a state where one end of the urging member contacts the rotary shaft of the roller member, and a plate member made of metal and disposed between the cover member and the urging member. The plate member comprises a first segment extending along a surface of the conveying path facing side of the cover member and contacting an other end of the urging member, a second segment extending from an edge of the first segment in a direction toward the conveying path, and a third segment extending from an edge of the second segment in a direction different from the direction in which the second segment extends.

Other objects, features, and advantages will be apparent to persons of ordinary skill in the art from the following detailed description of the invention and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the invention, the needs satisfied thereby, and the features and technical advantages thereof, reference now is made to the following descriptions taken in connection with the accompanying drawings.

FIG. **1** is an external perspective view of a multi-function device according to an embodiment of the invention.

FIG. **2** is an external perspective view of the multi-function device in which a top cover and a cover tray are pivoted.

FIG. **3** is a cross-sectional view showing a structure of a sheet cover that comprises a sheet conveying unit, according to an embodiment of the invention.

FIG. **4** is an enlarged cross-sectional view showing a structure of the sheet conveying unit.

FIG. **5** is an enlarged cross-sectional view of the sheet conveying unit in a state where the top cover is pivoted.

FIG. **6** is an external perspective view showing a structure of the top cover.

FIG. **7** is a exploded perspective view of the top cover.

FIG. **8** is a cross-sectional view of the sheet conveying unit taken along a roller shaft.

FIG. **9** is a cross-sectional view showing a shaft holding portion and its vicinity.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the invention and their features and technical advantages may be understood by referring to FIGS. **1-9**, like numerals being used for like corresponding parts in the various drawings.

A sheet conveying device according to an embodiment of the invention, e.g., a sheet conveying unit **50** of a multi-function device **1**, will be described in detail while referring to the drawings.

A general structure of the multifunction device **1** according to an embodiment of the invention will be described in detail while referring to the drawings.

In the following description, directions are defined when the multi-function device is disposed in an orientation in which it is intended to be used. In FIG. **1**, bottom left is defined as front, and top right is defined as rear. Left and right are defined when the multi-function device **1** is viewed from the front and, in FIG. **1**, top left is defined as left, and bottom right is defined as right.

As shown in FIG. **1**, the multi-function device **1** comprises a housing **10** and a sheet cover **30**. The housing **10** stores therein various components for performing various functions (a scanning function, a facsimile function, and a printing function).

The housing **10** comprises, at the front top thereof, an operation panel **11** including operating portions, and a liquid display **13** for displaying various information.

The operation panel **11** is used to input various instructions to the multi-function device **1**. A sheet cassette **12** is removably attached to the front of the housing **10**. The sheet cassette **12** is configured to store therein a stack of recoding media, e.g., sheets.

As shown in FIGS. **1** to **3**, the housing **10** comprises, at the top thereof, a scanner unit **20**. As shown in FIG. **3**, the scanner unit **20** comprises a contact glass **21** served as a document

holder, an image sensor **22**, a slide shaft, and a motor. The contact glass **21** is a so-called platen glass and has a rectangular shape larger than A4 size. A long side of A4 size extends in a left-right direction of the housing **10**.

The image sensor **22** is a so-called contact image sensor (CIS) and is configured to scan an image of a document sheet placed on the contact glass **21**. The image sensor **22** has a scanning range, which corresponds to a length of a short side of A4 size, in a scanning direction (i.e., a front-rear direction of the housing **10**). The image sensor **22** is held by the slide shaft extending in the left-right direction of the housing **10** so as to be slidable in the left-right direction within a predetermined range (a range corresponding to the long side of A4 size). In the multi-function device **1**, based on control of a motor by a controller, the image sensor **22** slides along the slide shaft and scans an image of a document sheet placed on the contact glass **21**.

The controller comprises a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM) and controls, as a control center, various functions of the multi-function device **1**. The controller is configured to execute controls desired by the user, based on inputs by the user from the operation panel **11**. The controller is further configured to control the liquid display **13** to display various information based on inputs by the user from the operation panel **11** and results of computation.

A facsimile unit is configured to transmit an image of a document sheet scanned by the scanner unit **20** via a network to a recipient desired by the user. The facsimile unit is further configured to receive data via the network. The controller controls an image forming unit to output the data received by the facsimile unit onto a sheet fed from the sheet cassette **1**.

The image forming unit is configured to print out input image data on a sheet fed from the sheet cassette **12**, based on control by the controller. The multi-function device **1** performs a copying function by controlling the image forming unit to process image data of an image scanned by the scanner unit **20**. The multi-function device **1** performs a printing function by controlling the image forming unit to process print data input via the network.

A sheet cover **30** is configured to pivot about an axis located at the rear top end of the housing **10** so as to be opened and closed. As shown in FIG. **3**, when the sheet cover **30** is closed, the sheet cover **30** covers an upper surface of the housing **10**, (i.e., the contact glass **21**). Thus, when the sheet cover **30** is closed, the sheet cover **30** securely holds a document sheet set on the contact glass **21**.

The sheet cover **30** comprises a cover tray **31**, sheet guide members **32**, a sheet guide surface **33**, and a sheet conveying unit **50** (i.e., an automatic document feeder (ADF)). As shown in FIGS. **1** to **3**, the cover tray **31** is configured to pivot about a pivot shaft formed at an end of the cover tray **31** and located at a central portion of an upper surface of the sheet cover **30**. As shown in FIG. **1**, when the cover tray **31** is closed (hereinafter, this position is referred to as a closed position), the cover tray **31** defines an outer surface of the sheet cover **30** which is flush with an outer surface of the sheet conveying unit **50** (i.e., a surface of a cosmetic cover D).

A surface of the cover tray **31** which becomes an outer surface of the sheet cover **31** when the cover tray **31** is in the closed position is referred to as a first surface, and a surface opposite to the first surface is referred to as a second surface. The second surface of the cover tray **31** is an inner surface of the cover tray **31** when the cover tray **31** is in the closed position.

As shown in FIGS. **2** and **3**, when the cover tray **31** is pivoted by a predetermined degree to an operating position, a pair of sheet guide members **32** and the sheet guide surface **33** are exposed outwardly. Each of the sheet guide members **32** is slidable in a front-rear direction on the sheet guide surface **33** which is formed below the cover tray **31**. The sheet guide members **32** are linked by a linking mechanism such that one of the sheet guide members **32** slides in one direction while the other of the sheet guide members **32** slides in a direction opposite to the one direction. By operating one of the sheet guide members **32**, the sheet guide members **32** slide close to or away from each other, and a distance between the sheet guide members **32** can be adjusted. By operating the sheet guide members **32**, a document sheet is properly positioned between the sheet guide members **32** and is prevented from skewing relative to a sheet conveying direction.

The sheet guide members **32** each comprise a partition plate **32**A. The partition plate **32**A is formed above the sheet guide surface **33** so as to be spaced by a predetermined distance from the sheet guide surface **33**.

As shown in FIGS. **2** and **3**, when the cover tray **31** is in the operating position, the second surface of the cover tray **31** faces upward and is inclined downward toward the sheet guide surface **33**. In this state, document sheets can be stacked on the second surface of the cover tray **31**.

A recess is formed below the pivot shaft of the cover tray **31** such that a pivot shaft-side end of the cover tray **31** passes a space defined by the recess. The recess allows the cover tray **31** to pivot about the pivot shaft smoothly. The recess allows the sheet guide surface **33** and the pivot shaft of the cover tray **31** to be vertically close to each other. This makes the sheet cover **30** slim.

The sheet conveying unit **50** is integrally formed with a left side portion of the sheet cover **30**. The sheet conveying unit **50** is configured to sequentially feed document sheets placed on the second surface of the cover tray **31** and the sheet guide surface **33**. The sheet conveying unit **50** is configured to separate the fed document sheets one by one, and to convey the separated document sheet along a conveying path R (shown in FIG. **4**). The scanner unit **20** of the multi-function device **1** scans an image of the document sheet while the sheet conveying unit **50** conveys the document sheet.

As shown in FIG. **3**, the conveying path R extends from the second surface of the cover tray **31** and the sheet guide surface **33**, has a U shape, and extends to surfaces of the partition plates **32**A of the sheet guide members **32**. The conveying path R extends along a left-right direction of the sheet conveying unit **50**. In this embodiment, a direction directed from the sheet guide surface **33** toward the partition plates **32**A along the conveying path R is referred to as a sheet conveying direction. A width direction of a document sheet refers to a direction of the width of a document sheet conveyed along the conveying path R (i.e., a front-rear direction of the sheet conveying unit **50**.

As shown in FIGS. **1** to **4**, the sheet conveying unit **50** comprises a unit main body **60** and a top cover **70**. The unit main body **60** is disposed at a lower portion of the sheet conveying unit **50** and functions as a main portion of the sheet conveying unit **50**. The top cover **70** is disposed at an upper portion of the sheet conveying unit **50** and is configured to pivot about a left end of the sheet conveying unit **50**, as shown in FIGS. **1** to **5**. An inner surface (lower surface) of the top cover **70** and an upper surface of the unit main body **60** define a part of the conveying path R.

The cosmetic cover D is removably attached to an outer surface of the top cover **70** (i.e., an upper surface of the sheet conveying unit **50**). The cosmetic cover D is made of transparent resin and cooperates with an upper surface of the top cover **70** to hold a cosmetic sheet having a predetermined

pattern. The pattern of the cosmetic sheet is visible through the cosmetic cover D. The cosmetic sheet can be replaced with a cosmetic sheet having a different pattern by removing the cosmetic cover D from the top cover **70**.

As shown in FIGS. **3** and **4**, the unit main body **60** comprises a conveying roller pair **61**, a driving conveying roller **62**, and a sheet holder **63**. The unit main body **60** defines, inside thereof, a part of the conveying path R. As described above, the upper surface of the unit main body **60** and the inner surface of the top cover **70** define a part of the conveying path R that continues from a part of the conveying path defined inside of the unit main body **60**.

As shown in FIGS. **3** and **4**, the conveying roller pair **61** comprises a pair of rollers which are opposed to each other via the conveying path R and are controlled by the controller to rotate while sandwiching a document sheet conveyed along the conveying path R. The driving conveying roller **62** is disposed along the upper surface of the unit main body **60** and is configured to rotate and convey the document sheet conveyed along the conveying path R, which is formed along the upper surface of the unit main body **60**, toward upper surfaces of the partition plates **32**A of the sheet guide members **32**.

The sheet holder **63** is disposed upstream of the conveying roller pair **61** in the sheet conveying direction and is configured to press the document sheet conveyed along the conveying path R against the contact glass **21**. When the scanner unit **20** of the multi-function device **1** scans an image of the document sheet conveyed by the sheet conveying unit **50**, the image sensor **22** is located below the sheet holder **63**. The scanner unit **20** scans, via the contact glass **21**, the image of the document sheet passing below the sheet holder **63**. At this time, because the document sheet is pressed by the sheet holder **63** against the contact glass **21**, the scanner unit **20** can scan the image at a high precision.

As described above, the top cover **70** is disposed at the upper portion of the sheet conveying unit **50** and is configured to pivot about the left end of the sheet conveying unit **50**. The inner surface (lower surface) of the top cover **70** and the upper surface of the unit main body **60** define a part of the conveying path R. As shown in FIGS. **4** to **6**, the top cover **70** comprises side wall portions **71**, guide ribs **72**, and a positioning portion **75**. A driven conveying roller **80**, a plate member **85**, and coil springs **90** are attached to the top cover **70**.

As shown in FIGS. **6** and **7**, the side wall portions **71** are disposed along a front end and a rear end of the top cover **70** (along a bottom right end and a top left end of the top cover **70** shown in FIGS. **6** and **7**), and project toward the conveying path R (upward in FIGS. **6** and **7**). The side wall portions **71** each have rigidity greater than that of a remaining portion (e.g., a central portion) of the top cover **70**.

As shown in FIGS. **6** and **7**, the guide ribs **72** are arranged at predetermined intervals on the inner surface of the top cover **70** and project toward the conveying path R. An end face of each guide rib **72** has an arc shape. The document sheet conveyed along the conveying path R contacts the end faces of the guide ribs **72** and are guided along the arc-shaped end faces of the guide ribs **72** toward the driving conveying roller **62**. The guide ribs **72** can reduce a contact area between the sheet conveying unit **50** and the document sheet. Thus, the sheet conveying unit **50** can convey the document sheet along the conveying path R while reducing a friction between the sheet conveying unit **50** and the document sheet.

The positioning portion **75** of the top cover **70** are opposed to a position where the driving conveying roller **62** is disposed in the unit main body **60**. The positioning portion **75** comprise ribs projecting so as to define, in the top cover **70**, a predetermined area that extends in the width direction of the document sheet (a front-rear direction of the multi-function device **1**). The positioning portion **75** is configured to position a plate member **85**, which is described later, at a predetermined position of the top cover **70**.

Shaft holding portions **76**, spring holding portions **77**, and reinforcing ribs **78** are formed in the positioning portion **75**. As shown in FIGS. **6** and **7**, the shaft holding portions **76** project in proximity to and along the side wall portions **71**, respectively. As shown in FIG. **9**, each of the shaft holding portions **76** has a groove for holding a corresponding one of opposite ends of a roller shaft **82** of the driven conveying roller **80**.

As shown in FIGS. **6** and **7**, two spring holding portions **77** are disposed in a projecting manner on the top cover **70** at a predetermined interval in the width direction of the conveying path R (the front-rear direction of the multi-function device **1**). As shown in FIG. **4**, each of the spring holding portions **77** is inserted into a corresponding coil spring **90** thereby to position and hold the coil spring **90**.

As shown in FIG. **7**, each of the reinforcing ribs **78** is formed in proximity to a corresponding side wall portion **71** and a corresponding shaft holding portion **76**, and projects slightly toward the conveying path R along the corresponding side wall portion **71**.

Structures of the driven conveying roller **80**, the plate member **85**, and the coil springs **90**, which are attached to the top cover **70**, will be described in detail while referring to the drawings. As shown in FIGS. **4** and **5**, the driven conveying roller **80** is rotatably disposed on the top cover **70** so as to oppose the driving conveying roller **62** via the conveying path R. The driven conveying roller **80** cooperates with the driving conveying roller **62** to convey the document sheet downstream along the conveying path R.

The driven conveying roller **80** comprises roller bodies **81** and a roller shaft **82**. The roller bodies **81** contact the document sheet conveyed along the conveying path R and are formed by a cylindrical rubber or the like. The roller shaft **82** is a rotary shaft of the driven conveying roller **80** and extends in the width direction of the conveying path R. As shown in FIGS. **6** and **7**, opposite ends of the roller shaft **82** are rotatably held by the shaft holding portions **76**, respectively. Three roller bodies **81** are disposed around the roller shaft **82** at predetermined intervals along the width direction of the conveying path R.

As shown in FIGS. **6** to **8**, the coil springs **90** are urging members configured to urge the driven conveying roller **80** toward the conveying path R, and are disposed between the top cover **70** and the roller shaft **82**. As described above, the coil springs **90** are inserted into the spring holding portions **77**, respectively, thereby to be positioned at predetermined two locations.

The plate member **85** is a plate-like member made of metal and has a first segment **86**, a second segment **87**, and a third segment **88**. As shown in FIGS. **6** and **7**, the plate member **85** is disposed in the positioning portion **75** of the top cover **70**. In the positioning portion **75**, the first segment **86** is interposed between the coil springs **90** and the top cover **70**. The first segment **86** is a flat segment of the plate member **85** and extends along and in contact with the inner surface of the top cover **70**. The first segment **86** comprises extending portions **86**A and a reinforcing portion **86**B. The extending portions **86**A positionally correspond to the spring holding portions **77** in the positioning portion **75** and extend from the second segment **87** by a predetermined distance. Thus, as shown in FIGS. **6** and **8**, the extending portions **86**A each contacts one end of a corresponding coil spring **90**. The reinforcing portion **86**B is a remaining portion of the first segment **86** other than

the extending portions **86**A and extends from the second segment **87** by a distance less than the predetermined distance.

As shown in FIGS. **5** to **9**, the second segment **87** is a flat segment of the plate member **85** and extends from an upstream edge of the first segment **86** (i.e., the extending portion **86**A and the reinforcing portion **86**B) in the sheet conveying direction toward the conveying path R. The second segment **87** extends to a position proximate to the conveying path R (e.g., a position proximate to the end face of each guide rib **72**), and does not extend beyond the sheet conveying path R. The third segment **88** is a flat segment of the plate member **85** and extends, along the conveying path R, from a conveying path-side edge of the second segment **87**. As shown in FIGS. **4** and **5**, the third segment **88** extends in a direction defined by the projecting ends of the guide ribs **72** proximate to the positioning portion **75**. An extending end of the third segment **88** extends to a position proximate to each roller body **81** and guides the document sheet conveyed from an upstream side of the conveying path R to a nip position between each roller body **81** and the driving conveying roller **62**.

How to attach the driven conveying roller **80**, the plate member **85**, and the coil springs **90** to the top cover **70** will be described in detail while referring to the drawings. As shown in FIG. **5**, the plate member **85** is first attached into the positioning portion **75** of the top cover **70**. As described above, because the positioning portion **75** is defined by the ribs, the plate member **85** is positioned in a predetermined position of the top cover **70**. As shown in FIG. **7**, the extending portions **86**A partially constitute the first segment **86** of the plate member **85** and each have a through hole for a corresponding spring holding portion **77**. By attaching the plate member **85** to the top cover **70** such that the spring holding portions **77** are inserted into the through holes of the extending portions **86**A, the plate member **85** is positioned in the predetermined position of the top cover **70**. At this time, the first segment **86** of the plate member **85** contacts the inner surface of the top cover **70** (i.e., a conveying path facing surface of the top cover **70**). Specifically, as shown in FIG. **9**, when the plate member **85** is in the positioning portion **75**, opposite end portions, in the width direction of the document sheet, of the first segment **86** of the plate member **85** contact projecting ends of the reinforcing ribs **78**, respectively.

After the plate member **85** is positioned in the positioning portion **75**, the coil springs **90** are placed on the spring holding portions **77**. Specifically, when the spring holding portions **77** are inserted into the coil springs **90**, the coil springs **90** are positioned on the extending portions **86**A of the plate member **85**. As shown in FIGS. **4**, **6**, and **8**, one end of each coil spring **90**, which is positioned by a corresponding spring holding portion, contacts a corresponding extending portion **86**A of the plate member **85**.

Then, in a state where the plate member **85** and the coil springs **90** are positioned in the positioning portion **75**, the driven conveying roller **80** is attached to the top cover **70** via the shaft holding portions **76**. As shown in FIG. **6**, each spring holding portion **77** is located between the roller bodies **81** and is opposed to the roller shaft **82**. Thus, the other end of each coil spring **90** contacts the roller shaft **82** of the driven conveying roller **80**.

As shown in FIG. **6**, when opposite ends of the roller shaft **82** are fitted into the grooves of the shaft holding portions **76** of the top cover **70**, respectively, the shaft holding portions **76** cooperate with the coil springs, which generate urging force to the roller shaft **82**, to support the driven conveying roller **80** rotatably. The driven conveying roller **80** is positioned on the conveying path side of the positioning portion **75** and extends along the width direction of the conveying path R.

The driven conveying roller **80** is attached to the top cover **70** such that the roller shaft **82** of the driven conveying roller **80** is held by the shaft holding portions **76** while the roller shaft **82** contacts one end of each coil spring **90** in a state where the other end of each coil spring **90** contacts the first segment **86** of the plate member **85**.

The driven conveying roller **80** is attached to the top cover **70** such that the roller shaft **82** is held by the roller holding portions **76** while the roller shaft **82** contacts one end of each coil spring **90** in a state where the other end of each coil spring **90** contacts the first segment **86** of the plate member **85**. When the driven conveying roller **80**, the plate member **85**, and the coil springs **90** are attached to the top cover **70**, no extra members, such as screws, are not used. Thus, in the multi-function device **1**, a worker can readily assemble, replace, and disassemble the driven conveying roller **80**, the plate member **85**, and the coil springs relative to the top cover **70**.

As typically shown in FIG. **4**, in the multi-function device according to the above-described embodiment, because the coil springs **90** are disposed between the roller shaft **82** of the driven conveying roller **80** and the first segment **86** of the plate member **85**, the driven conveying roller **80** are urged toward the driving conveying roller **62** via the conveying path R. Consequently, in the multi-function device **1**, the roller bodies **81** of the driven conveying roller **80** are reliably brought into contact the document sheet conveyed along the conveying path R and are sandwiched between the driven conveying roller **80** and the driving conveying roller **62**. When the driving conveying roller **62** is driven to rotate, the document sheet is conveyed along the conveying path R.

The plate member **85** is made of metal and comprises the first segment **86**, the second segment **87**, and the third segment **88**. The rigidity of the plate member **85** is greater than that of the top cover **70** which is made of resin. Because the urging force of the coil springs **90** is applied to the pate member **85**, the top cover **70** can be prevented from deforming. Even when the top cover **70** is made thin, the plate member **85** prevents the top cover **70** from deforming due to the urging force of the coil springs **90**. Thus, the multi-function device **1** can be made compact and slim.

As shown in FIG. **4**, the third segment **88** of the plate member **85** extends along a direction defined by the projecting ends of the guide ribs **72** proximate to the positioning portion **75**. Thus, the third segment **88** functions as a guide for guiding the document sheet downstream along the conveying path R. In the multi-function device **1**, the plate member **85** can prevent deformation of the top cover **70** and facilitate a smooth conveyance of the document sheet along the conveying path R.

The third segment **88** of the plate member **85** is disposed adjacent to and upstream, in the sheet conveying direction, of the driven conveying roller **80**. In the multi-function device according to the above-described embodiment, the plate member **85** can prevent deformation of the top cover **70**. Thus, the positional relation among the plate member **85**, the driven conveying roller **80**, and the driving conveying roller **62** can be maintained while displacement of the top cover **70** is prevented, and a stable conveyance of the document sheet can be achieved.

As typically shown in FIG. **7**, the first segment **86** of the plate member **85** comprises the extending portions **86**A and the reinforcing portion **86**B. Because the extending portion **86**A has the through hole into which the spring holding portion **77** is inserted, the extending portion **86**A reliably contacts one end of the coil spring **90** fitted around the spring

holding portion **77**. The reinforcing member **86**B is formed such that the first segment **86** extends across the entire width of the conveying path R. This increases the rigidity of the plate member **85**. As shown in FIGS. **6** and **7**, because the extending distance of the reinforcing portion **86**B from the second segment **87** of the plate member **85** is less than that of the extending portion **86**, the size of the first segment **86** is minimized. Thus, the cost of the plate member **85** can be reduced.

Opposite ends of the first segment **86** of the plate member **85** in the width direction of the document sheet respectively contact the reinforcing ribs **78** that are formed in proximity of the respective side wall portions **71**. Because the side wall portions **71** are formed respectively along the opposite ends in the width direction of the top cover **70** and extend toward the conveying path R, the rigidity of portions of the top cover **70** proximate to the side wall portions **71** are greater than that of the remaining portion of the top cover **70**. The reinforcing ribs **78**, which are formed respectively along the side wall portions **71**, further increase the rigidity of the portions of the top cover **70** proximate to the side wall portions **71**. Because the reinforcing ribs **78** contact the first segment **86** of the plate member **85**, the urging force of the coil springs **90** can be spread to the portions of the top cover **70** having a relatively high rigidity. This can prevents deformation of the top cover due to the urging force of the coil springs **90**.

Although, in the above-described embodiment, the sheet conveying device is applied to the multi-function device, the sheet conveying device may be applied to a scanning device comprising an automatic document feeder (ADF).

Although, in the above-described embodiment, the driven conveying roller **80** and the driving conveying roller **62** are configured to sandwich the document sheet and to convey the document sheet along the conveying path R, the driving conveying roller **62** should not necessarily be provided so as to oppose the driven conveying roller **80** via the conveying path R. The driven conveying roller **80** may be replaced with a smooth surface as long as the driven conveying roller **80** is urged toward the conveying path R.

While the invention has been described in connection with embodiments of the invention, it will be understood by those skilled in the art that variations and modifications of the embodiments described above may be made without departing from the scope of the invention. Other embodiments will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. It is intended that the specification and the described examples are considered merely as exemplary of the invention, with the true scope of the invention being defined by the following claims.

What is claimed is:

1. A sheet conveying device comprising:

a cover member made of resin and defining a part of a conveying path along which a sheet is conveyed;

a roller member rotatably disposed on a conveying path facing side of the cover member and configured to convey the sheet along the conveying path, the roller member comprising a rotary shaft;

an urging member disposed between the cover member and the rotary shaft of the roller member and urging the roller member toward the conveying path in a state where one end of the urging member contacts the rotary shaft of the roller member;

a plate member made of metal and disposed between the cover member and the urging member,

wherein the plate member comprises:

a first segment extending along a surface of the conveying path facing side of the cover member and contacting an other end of the urging member,

a second segment extending from an edge of the first segment in a direction toward the conveying path, and

a third segment extending from an edge of the second segment in a direction different from the direction in which the second segment extends; and

a main body that defines the conveying path together with the cover member and comprises a driving roller, wherein the urging member urges the roller member toward the driving roller.

2. The sheet conveying device according to claim **1**, wherein the third segment extends from the edge of the second segment in a direction toward a downstream side in a sheet conveying direction in which the sheet is conveyed along the conveying path.

3. The sheet conveying device according to claim **1**, wherein the cover member comprises:

a positioning portion removably positioning the first segment of the plate member on the conveying path facing side of the cover member,

a shaft holding portion rotatably holding the rotary shaft of the roller member at a position separated by a predetermined distance from the positioning portion toward the conveying path, and

wherein the roller member is attached to the cover member such that the rotary shaft of the roller member is held by the shaft holding portion while the rotary shaft contacts the one end of the urging member in a state where the other end of the urging member contacts the first segment of the plate member positioned by the positioning portion.

4. The sheet conveying device according to claim **3**, wherein the positioning portion comprises a first positioning portion and a second positioning portion, and the shaft holding portion is disposed between the first positioning portion and the second positioning portion in a sheet conveying direction.

5. The sheet conveying device according to claim **1**, wherein the first segment of the plate member comprises:

an extending portion extending from the second segment by a predetermined distance and contacting the other end of the urging member, and

a reinforcing portion extending from the second segment by a distance less than the predetermined distance.

6. The sheet conveying device according to claim **1**, wherein the cover member comprises:

side wall portions disposed respectively at opposite ends of the cover member in a width direction of the sheet conveyed along the conveying path, and projecting toward the conveying path, the width direction being perpendicular to a sheet conveying direction, and

reinforcing ribs projecting respectively along the side wall portions and contacting the first segment of the plate member, wherein the first segment extends across the cover member in the width direction.

7. The sheet conveying device according to claim **1**,

wherein the cover member comprises a positioning portion positioning the plate member relative to the cover member and comprising a first engaging portion, and

wherein the plate member comprises a second engaging portion, and the second engaging portion of the plate member positioned by the positioning portion engages with the first engaging portion of the positioning member.

8. The sheet conveying device according to claim 7, wherein the first engaging portion of the positioning portion comprises a holding portion holding the urging member, and the second engaging portion of the plate member has a through hole formed in the first segment of the plate member.

9. The sheet conveying device according to claim 8, wherein the urging member comprises a coil spring that is inserted into the holding portion.

10. The sheet conveying device according to claim 1, wherein the third segment of the plate member is disposed upstream of the roller member in a sheet conveying direction and is exposed to the conveying path such that the third segment guides the sheet to the roller member along the conveying path.

11. The sheet conveying device according to claim 10,

wherein the cover member comprises guide ribs projecting toward the conveying path, and projecting ends of the guide ribs are configured to guide the sheet in the sheet conveying direction along the conveying path, and

wherein the third segment of the plate member is disposed downstream of the guide ribs in the sheet conveying direction and extends along a direction defined by the projecting ends of the guide ribs.

12. A sheet conveying device comprising:

a cover member made of resin and defining a part of a conveying path along which a sheet is conveyed;

a roller member rotatably disposed on a conveying path facing side of the cover member and configured to convey the sheet along the conveying path, the roller member comprising a rotary shaft;

an urging member disposed between the cover member and the rotary shaft of the roller member and urging the roller member toward the conveying path in a state where one end of the urging member contacts the rotary shaft of the roller member;

a plate member made of metal and disposed between the cover member and the urging member,

wherein the plate member comprises:

a first segment extending along a surface of the conveying path facing side of the cover member and contacting an other end of the urging member,

a second segment extending from an edge of the first segment in a direction toward the conveying path, and

a third segment extending from an edge of the second segment in a direction different from the direction in which the second segment extends; and

a main body that defines the conveying path together with the cover member and comprises a driving roller, wherein the urging member urges the roller member toward the driving roller,

wherein the third segment extends from the edge of the second segment in a direction toward a downstream side in a sheet conveying direction in which the sheet is conveyed along the conveying path, and

wherein the third segment of the plate member is disposed upstream of the roller member in the sheet conveying direction and adjacent to the roller member.

13. A sheet conveying device comprising:

a cover member made of resin and defining a part of a conveying path along which a sheet is conveyed;

a roller member rotatably disposed on a conveying path facing side of the cover member and configured to convey the sheet along the conveying path, the roller member comprising a rotary shaft;

an urging member disposed between the cover member and the rotary shaft of the roller member and urging the roller member toward the conveying path in a state where one end of the urging member contacts the rotary shaft of the roller member;

a plate member made of metal and disposed between the cover member and the urging member,

wherein the plate member comprises:

a first segment extending along a surface of the conveying path facing side of the cover member and contacting an other end of the urging member,

a second segment extending from an edge of the first segment in a direction toward the conveying path, and

a third segment extending from an edge of the second segment in a direction different from the direction in which the second segment extends; and

a main body, wherein the cover member is configured to pivot relative to the main body about an axis located at an end of the cover member, the end being upstream of the cover member in a sheet conveying direction.

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